

PUBLIC (REDACTED) VERSION

**BEFORE THE
PUBLIC SERVICE COMMISSION OF
SOUTH CAROLINA**

DOCKET NO. 2019-224-E

DOCKET NO. 2019-225-E

In the Matter of:

South Carolina Energy Freedom Act
(House Bill 3659) Proceeding Related to
S.C. Code Ann. Section 58-37-40 and
Integrated Resource Plans for Duke
Energy Carolinas, LLC and Duke Energy
Progress, LLC

**REBUTTAL TESTIMONY OF
NICK WINTERMANTEL
ON BEHALF OF DUKE ENERGY
CAROLINAS, LLC AND DUKE
ENERGY PROGRESS, LLC**

I. INTRODUCTION OF EXPERT WITNESS

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Nick Wintermantel, and my business address is 3000 Riverchase Galleria, Hoover, Alabama.

Q. BY WHOM ARE YOU EMPLOYED AND WHAT IS YOUR POSITION?

A. I am a Principal Consultant and Partner at Astrapé Consulting (“Astrapé”). Astrapé is a consulting firm that provides expertise in resource planning and resource adequacy to utilities across the United States and internationally.

Q. DID YOU PREVIOUSLY FILE DIRECT TESTIMONY IN THIS PROCEEDING?

A. Yes.

Q. ARE YOU PRESENTING ANY EXHIBITS IN SUPPORT OF YOUR REBUTTAL TESTIMONY?

A. Yes. I am presenting the following four exhibits:

- Wintermantel Rebuttal Exhibit 1: Environmental Parties’¹ Response to DEC/DEP Request for Production 1-9.
- Wintermantel Rebuttal Exhibit 2: Environmental Parties’ Response to DEC/DEP Interrogatory 1-29.
- Wintermantel Rebuttal Exhibit 3: Environmental Parties’ Response to DEC/DEP Interrogatory 1-31.
- Wintermantel Rebuttal Exhibit 4: CCEBA’s² Response to DEC/DEP Interrogatory 1-24 (c-i), 1-25 and 1-26.

¹ “Environmental Parties” refers to intervenors Natural Resources Defense Council, Southern Alliance for Clean Energy, Sierra Club, South Carolina Coastal Conservation League, and Upstate Forever.

² On June 26, 2019, the Commission issued Order Nos. 2019-467 and 2019-468 granting the South Carolina Solar Business Alliance, Inc.’s (“SCSBA”) petition for intervention in these proceedings. On March 10, 2021, the Commission issued Order No. 2021-167 granting SCSBA’s Motion to substitute CCEBA as the party of record and participant in these Dockets.

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1 **Q. WERE THESE EXHIBITS PREPARED BY YOU OR AT YOUR DIRECTION**
2 **AND UNDER YOUR SUPERVISION?**

3 A. Yes. These exhibits were prepared by me or at my direction and under my supervision.

4 **Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?**

5 A. The purpose of my rebuttal testimony is to respond to testimony from ORS Witness
6 Stephen Baron (of J. Kennedy and Associates, Inc. (“Kennedy Associates”)), ORS
7 Witness Anthony Sandonato, and Environmental Parties Witness James Wilson (of
8 Wilson Energy Economics) regarding the 2020 Resource Adequacy Study that Astrapé
9 prepared for DEC and DEP and Astrapé’s recommended reserve margin. While
10 Astrapé conducted a separate study for each utility, for ease of reference, my testimony
11 refers to the two studies collectively as the “Resource Adequacy Study.”

12 My rebuttal testimony also responds to testimony from Witness Sandonato and
13 Carolinas Clean Energy Business Association (“CCEBA”) Witness Arne Olson (of
14 Energy and Environmental Economics, Inc. (“E3”)), regarding the 2020 Storage
15 Effective Load Carrying Capability Study (“Storage ELCC Study”) and the 2018 Solar
16 Capacity Value Study. Each of these studies was also conducted by Astrapé for the
17 Companies. My rebuttal testimony is organized by each intervenor, beginning with my
18 response to the ORS, followed by my response to Witness Wilson and then my response
19 to Witness Olson.

1 **II. INTRODUCTION TO THE 2020 RESOURCE ADEQUACY STUDY**

2 **Q. PLEASE REINTRODUCE THE 2020 RESOURCE ADEQUACY STUDY THAT**
3 **ASTRAPÉ PERFORMED FOR THE COMPANIES.**

4 A. Astrapé was retained by the Companies in late 2019 to perform the 2020 Resource
5 Adequacy Study which determined the minimum reserve margin the Companies should
6 plan for in their respective IRPs. The Resource Adequacy Study determined the reserve
7 margin required to meet the reliability standard of “one day in 10 years” which equates
8 to a Loss of Load Expectation (“LOLE”) of 0.1 days/year. Based on the physical
9 reliability results of the Resource Adequacy Study, Astrapé recommended that the
10 Companies continue to maintain a minimum 17% winter reserve margin for IRP
11 purposes.

12 **Q. YOUR DIRECT TESTIMONY EXPLAINS THE “ONE DAY IN 10 YEARS”**
13 **STANDARD FOR RESOURCE PLANNING. DO ANY INTERVENORS**
14 **DISPUTE THIS AS AN APPROPRIATE TARGET FOR DETERMINING**
15 **RESERVE MARGIN?**

16 A. No intervenors dispute this standard as an appropriate target for determining reserve
17 margin. Specifically, Witness Baron, Witness Sandonato, Witness Wilson, and
18 Witness Olson agree that the one day in 10-year standard (LOLE of 0.1 days/year) is a
19 common metric used in resource adequacy studies.³

³ See ORS Baron Direct, at 7; ORS Report (DEC), at 36-44; ORS Report (DEP), at 36-44; CCEBA Olson Direct, at 8; Environmental Parties Wilson Direct, at 7.

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1 **Q. WHAT IS ORS'S OPINION ON THE REASONABLENESS OF ASTRAPÉ'S**
2 **RECOMMENDED 17% WINTER RESERVE MARGIN?**

3 A. ORS is supportive of Astrapé's recommended 17% reserve margin. The ORS Report
4 prepared by Kennedy and Associates, which is included in Witness Sandonato's Direct
5 Testimony as Exhibit AMS-1 and Exhibit AMS-2 (referred to collectively as the "ORS
6 Report"), concludes that "the Company's 17% winter peak reserve margin analysis
7 meets the requirements of Act 62, is reasonable and represents a high level of
8 methodological sophistication."⁴

9 **Q. HAVE ANY OTHER INDEPENDENT REGULATORY BODIES REVIEWED**
10 **THE 2020 RESOURCE ADEQUACY STUDY?**

11 A. Yes. The North Carolina Public Staff reviewed the Resource Adequacy Study and filed
12 comments with the North Carolina Utilities Commission ("NCUC") in the North
13 Carolina IRP companion docket to these dockets, finding that the 17% winter reserve
14 margin was adequate for planning purposes.⁵

15 **III. RESPONSE TO ORS**

16 **Q. PLEASE PROVIDE A SUMMARY OF THE CONCLUSIONS REACHED BY**
17 **ORS IN REGARD TO THE 2020 RESOURCE ADEQUACY STUDY.**

18 A. Based on the ORS Report, Kennedy and Associates performed an extensive review of
19 the 2020 Resource Adequacy Study and the associated workpapers provided by the
20 Companies through discovery. The ORS Report states that "[o]verall, ORS concludes
21 that the Company's 17% winter peak reserve margin analysis meets the requirements

⁴ ORS Report (DEC), at 44; ORS Report (DEP), at 44.

⁵ Comments of the Public Staff, at 69-75, N.C.U.C. Docket No. E-100, Sub 165 (filed Feb. 26, 2021).

of Act 62, is reasonable and represents a high level of methodological sophistication. The methodology used by the Company to develop its analysis, which uses the SERV model to perform a Monte Carlo analysis that incorporates probability-based risk profiles for numerous factors that affect resource adequacy is also reasonable.”⁶

Q. KENNEDY AND ASSOCIATES PERFORMED A SURVEY OF OTHER WINTER PLANNING WINTER RESERVE MARGINS IN THE MID-ATLANTIC AND SOUTHEAST AREAS. DO YOU AGREE WITH THE ASSESSMENT THAT THE COMPANIES’ RESERVE MARGIN FALLS WITHIN THE RANGE OF OTHER UTILITIES IN THE REGION?

A. Yes, I do. As shown in Table 10 in the ORS Report (which is provided below as my Rebuttal Figure 1), the Companies’ reserve margin is consistent with the other utilities and falls on the low end of the range of the planning reserve margins in the region.⁷

**Wintermantel Rebuttal Figure 1:
Comparison of Utility Winter Peak Reserve Margins**

Table 10	
Comparison of Utility Winter Peak Reserve Margins	
<u>Utility</u>	<u>Winter Peak Reserve Margin</u>
DEP/DEC	17%
Dominion Energy South Carolina	21%
Southern Company	26%
TVA	25%
Louisville Gas and Electric/ Kentucky Utilities	17% to 25%
Florida Power and Light Co.	20%

⁶ ORS Report (DEC), at 44; ORS Report (DEP), at 44.

⁷ *Id.*

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1 **Q. WHY DO YOU BELIEVE THE COMPANIES' TARGET WINTER RESERVE**
2 **MARGIN IS LOWER THAN SURROUNDING NEIGHBORS?**

3 A. I expect this is due to specific assumptions in the Companies' Resource Adequacy
4 Study including significant neighbor assistance during cold weather events from PJM
5 and other regions, as well as an economic load forecast uncertainty modeling that
6 slightly decreased the planning reserve margin. Typically, economic load forecast
7 uncertainty would increase LOLE risk by putting upward pressure on reserves;
8 however, based on stakeholder feedback from the stakeholder meetings held by the
9 Companies and Astrapé in preparing the Resource Adequacy Study, the symmetric load
10 forecast uncertainty used in the 2016 Resource Adequacy Study was changed to an
11 asymmetric distribution for the 2020 Resource Adequacy Study. The Companies also
12 enjoy fairly low outage rates across their generation fleet. A combination of these
13 factors along with the fact that almost all LOLE is in the winter⁸ likely causes the winter
14 reserves to be a few percentage points lower than the other regions.

⁸ If more of the LOLE was in the summer (*i.e.*, 0.05 of the 0.1 allowed LOLE), then the winter would only be allowed 0.05 events per year resulting in a more stringent target and increasing winter reserve margin further.

1 **Q. WHILE ORS STATES THAT THE COMPANIES' COLD WEATHER LOAD**
2 **MODELING ANALYSIS WAS NOT UNREASONABLE, ORS DESCRIBES**
3 **SOME CONCERN ABOUT THE ABILITY OF THE MODEL TO**
4 **ACCURATELY MEASURE THE EFFECT OF EXTREME LOW**
5 **TEMPERATURES ON LOAD.⁹ WHY IS THE RELATIONSHIP BETWEEN**
6 **LOAD AND EXTREME WEATHER IMPORTANT?**

7 A. As ORS correctly points out, how load reacts to extreme cold weather events is one of
8 the significant drivers of the level of required winter reserves needed to maintain the
9 LOLE 0.1 standard.¹⁰

10 **Q. PLEASE EXPLAIN HOW ASTRAPÉ MEASURED THE IMPACT OF**
11 **WEATHER ON LOAD.**

12 A. In order to measure the impact of weather on load, an “artificial neural network”
13 (“ANN”) was developed to predict how load will respond to historic temperatures
14 based on how load actually responded to weather during the five-year period from
15 January 2014 to September 2019 (this period of time was used as the model “training
16 dataset”). The ANN develops weather-to-load relationships by season based on the
17 actual information available in the training dataset to create synthetic load shapes for
18 the past 39 years of weather (1980-2018). The intent of this analysis is to predict how
19 load will respond under a variety of weather conditions and to capture the frequency of
20 mild or severe weather over the last 39 years.

⁹ ORS Report (DEC), at 39; ORS Report (DEP), at 39.

¹⁰ ORS Report (DEC), at 34; ORS Report (DEP), at 34.

1 **Q. IN EVALUATING THE RELATIONSHIP BETWEEN WEATHER AND**
2 **LOAD, WHY IS IT NOT APPROPRIATE TO USE THE ACTUAL LOAD**
3 **ASSOCIATED WITH THE HISTORIC 39 YEARS OF WEATHER?**

4 A. While historic load data exists from 10, 30 or even 40 years ago, the significant changes
5 that have occurred in the industry and to customer behavior make this data not useful.
6 For example, significant load growth from all sectors has taken place in the last 30
7 years and the way customers use electricity is different. Therefore, load data from the
8 most recent five years is used to estimate the load response under various weather
9 conditions.

10 **Q. DID ASTRAPÉ TAKE ADDITIONAL STEPS TO ANALYZE THE**
11 **RELATIONSHIP BETWEEN LOAD AND EXTREME COLD**
12 **TEMPERATURES?**

13 A. Yes. As mentioned by ORS, the extreme cold weather experienced in earlier years has
14 not occurred during the five-year training dataset. Because extreme temperatures can
15 be rare, they will not always occur during the recent five-year training dataset. As such,
16 an improvement was required to adjust the ANN results for the extreme temperatures
17 not seen in the training dataset. For this improvement, Astrapé created a linear
18 regression which predicts the expected load based on a linear relationship developed
19 between recent low temperature hours and the resulting historical hourly load. As
20 shown in the ORS Report, the regression Astrapé used for DEC had an R^2 of 0.95,
21 indicating that 95% of the DEC load variability could be explained by temperature.¹¹
22 As explained later in my rebuttal testimony in response to Witness Wilson, the

¹¹ ORS Report (DEC), at 38.

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1 regression used by Astrapé provided a reasonable fit through the available data points
2 in recent history.

3 **Q. IS THE PROCESS YOU HAVE DESCRIBED TO FURTHER ANALYZE THE**
4 **RELATIONSHIP BETWEEN LOAD AND EXTREME COLD**
5 **TEMPERATURES COMMON IN YOUR RESOURCE ADEQUACY WORK?**

6 A. Yes. This is common in our resource adequacy work in other jurisdictions. Because
7 some historical extreme temperatures have not been seen recently, the loads for these
8 extreme temperatures are not predicted well by the ANN and require additional
9 analysis.

10 **Q. WHAT RECOMMENDATIONS DID ORS MAKE WITH REGARD TO THE**
11 **METHODOLOGY USED TO MODEL THE RELATIONSHIP BETWEEN**
12 **LOAD AND THE EXTREME COLD WEATHER?**

13 A. ORS made two recommendations. First, ORS recommends the Companies further
14 develop the methodology to model the effects of extreme low temperatures on winter
15 peak load and address this through future IRP stakeholder meetings.¹² Second, ORS
16 recommends that in future IRPs the Companies provide a more detailed discussion of
17 the specific methodology used to develop the modeled loads for extreme low
18 temperature periods.¹³

¹² ORS Report (DEC), at 44; ORS Report (DEP), at 44-45.

¹³ ORS Report (DEC), at 44; ORS report (DEP), at 45.

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1 **Q. IN REGARD TO STAKEHOLDER MEETINGS, DID THE COMPANIES**
2 **PROVIDE OPPORTUNITIES FOR STAKEHOLDERS TO REVIEW THE**
3 **COLD WEATHER REGRESSION RESULTS PRIOR TO THE 2020**
4 **RESOURCE ADEQUACY STUDY BEING PERFORMED?**

5 A. Yes. The Companies and Astrapé held several stakeholder meetings that took place as
6 part of the development of the Resource Adequacy Study. These stakeholder meetings
7 were used to discuss major assumptions in the study including the cold weather peak
8 load modeling. The regression equations were presented and explained to stakeholders
9 and the Companies requested feedback on the major assumptions to be used in the study
10 prior to performing the simulations for the study. Being that ORS and other entities
11 did not provide feedback in relation to the regression inputs, Astrapé moved forward
12 assuming all parties agreed with the assumptions in the study.

13 **Q. DO YOU AGREE WITH ORS'S RECOMMENDATION THAT THE**
14 **COMPANIES SHOULD CONTINUE TO STUDY AND DEVELOP**
15 **METHODOLOGIES FOR MODELING COLD WEATHER LOADS IN**
16 **FUTURE STUDIES?**

17 A. While I agree methodologies can and should always be improved, until extreme cold
18 temperatures are experienced in a recent year, the load response for those extreme
19 temperatures will continue to be a projection using the best data available, which I
20 believe the Resource Adequacy Study has utilized. As seen in Texas and surrounding
21 regions in February of this year, it is critical to understand the impact cold weather has
22 on loads. These actual events provide data points to be included in the modeling and
23 the analysis should be continually reviewed as the Companies move forward.

1 **Q. DO YOU AGREE WITH ORS’S RECOMMENDATION THAT IN FUTURE**
2 **IRPs THE COMPANIES SHOULD PROVIDE A MORE DETAILED**
3 **DISCUSSION OF THE SPECIFIC METHODOLOGY USED TO DEVELOP**
4 **THE SYNTHETIC LOADS FOR EXTREME LOW TEMPERATURE**
5 **PERIODS?**

6 A. Yes. As noted by ORS,¹⁴ the Companies, through Astrapé, have already provided this
7 information through discovery in this proceeding and I believe this is a reasonable
8 recommendation for future IRPs.

9 **Q. LASTLY, THE ORS REPORT DISCUSSES HOW SIGNIFICANTLY THE**
10 **COLDEST WEATHER YEARS (1982 AND 1985) IN THE STUDY IMPACT**
11 **THE RESERVE MARGIN RESULTS.¹⁵ THE ORS REPORT PROVIDES**
12 **ANALYSIS OF HOW THE RESERVE MARGIN WOULD CHANGE IF**
13 **CERTAIN COLD WEATHER YEARS WERE EXCLUDED.¹⁶ HOW DO YOU**
14 **RESPOND TO THIS?**

15 A. Astrapé does not refute the results of ORS’s analysis that removing the two coldest
16 weather years lowers the reserve margin results. The major flaw with ignoring the
17 coldest weather years is that it eliminates a known risk that customers face. It is prudent
18 to prepare for temperatures that have occurred historically even if they have not
19 occurred recently. The most accurate way to capture extreme weather risk is by
20 representing the frequency of cold weather events based on historical data. Each of the
21 39 weather years has an equal probability of being selected by the model, so the years

¹⁴ ORS Report (DEC), at 44; ORS Report (DEP), at 44.

¹⁵ ORS Report (DEC), at 39; ORS Report (DEP), at 39.

¹⁶ ORS Report (DEC), at 40; ORS Report (DEP), at 40.

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1 with extreme cold weather were not given any more weight than milder years.
2 Removing the most extreme weather years artificially deflates the reserve margin and
3 allows the probability of firm load shed to be higher in more mild years, which in turn
4 puts customers more at risk. If weather from 1985 (which represents the coldest year
5 in the last 39 years) occurs again, and the Companies have a 17% reserve margin, it is
6 expected that there will be a high likelihood of load shed but that in less extreme cold
7 weather years such as 2014, 2015, and 2018, the risk will be better managed. However,
8 if 1985 weather is removed from the Resource Adequacy Study arbitrarily and the
9 reserve margin is lowered, the Companies would now expect to have increased risk in
10 these milder weather years due to a lower planning reserve margin. This rationale goes
11 against the purpose of the study, which is to maintain reliability in all but a few extreme
12 periods. As a resource adequacy planner and modeler, I would be doing customers a
13 disservice in excluding risk that I knew was possible. There is no basis for assuming
14 1985 or 1982 weather will never occur again in the next 39 years. The Commission
15 certainly has the discretion to decide that the Companies should exclude the worst
16 weather year in the last 39 years in the modeling, but based on my professional
17 judgment as a resource planner, I strongly advise against that approach.

18 The recent events seen in ERCOT and the Southwest Power Pool (“SPP”)
19 demonstrate that the risk of severe weather remains an ongoing threat as temperatures
20 reached extremes in the region and both ERCOT and SPP had to shed customers’ load
21 due to capacity deficiencies.¹⁷ In fact, the recent ERCOT extreme weather, which

¹⁷ Bill Magness—President & Chief Executive Officer ERCOT, *Review of February 2021 Extreme Cold Weather Event-ERCOT Presentation*, at 10, 18, (Feb. 24, 2021), available at http://www.ercot.com/content/wcm/key_documents_lists/225373/2.2_ERCOT_Presentation.pdf.

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1 resulted in consecutive days of lost load across the state of Texas, had not been seen
 2 since 1989 (over 30 years ago). Further, EPRI recently released a report concluding
 3 that extreme weather events are occurring more, not less, frequently.¹⁸ The EPRI
 4 report¹⁹ states that:

5 Cold events are less cold on average but are increasing in frequency.
 6 The pace of record low temps is less than half of record high temps in
 7 the U.S. in the most recent two decades; this demonstrates “less cold on
 8 average.” Yet in the most recent decades, we are seeing a weaker winter
 9 jet stream that “allows” cold air from polar Canada to dip down into the
 10 northern half of the U.S. with greater frequency (e.g., creating cut-off
 11 lows, sometimes referred to as the Polar Vortex).

12 For all of these reasons, it would not be prudent to remove extreme temperatures
 13 that occur once in 39 years from the modeling. A resource adequacy planner must
 14 include a realistic representation of the risks and it is not prudent to remove data points
 15 simply because they include extreme weather. The frequency of these extreme weather
 16 events is exactly what should be captured in a resource adequacy study.

17 **Q. TURNING TO THE STORAGE ELCC STUDY AND THE SOLAR CAPACITY**
 18 **VALUE STUDY, WHAT ARE ORS’S CONCLUSIONS REGARDING THESE**
 19 **STUDIES?**

20 A. As stated in the ORS Report, “ORS has evaluated these two studies and has found them
 21 to be generally reasonable.”²⁰ DEC/DEP Witness Kalemba discusses any concerns
 22 raised by ORS in how the capacity values were used by the Companies’ resource
 23 expansion planning model.

¹⁸ *Exploring the Impacts of Extreme Events, Natural Gas Fuel and Other Contingencies on Resource Adequacy*. EPRI, Palo Alto, CA: 2021. 3002019300, available for download at <https://www.epri.com/research/programs/067417/results/3002019300>.

¹⁹ *Id.* at 4-2—4-5.

²⁰ ORS Report (DEC), at 43; ORS Report (DEP), at 43.

IV. RESPONSE TO WITNESS WILSON

Q. PLEASE PROVIDE A SUMMARY OF THE ISSUES THAT WITNESS WILSON ADDRESSES REGARDING THE RESOURCE ADEQUACY STUDY.

A. Witness Wilson concludes that the 17% reserve margin is unsupported and higher than necessary.²¹ Witness Wilson addresses three main issues with the Resource Adequacy Study: (1) the approach to estimating the impact of extreme cold temperatures on load; (2) the use of 39 years of equally weighted weather data; and (3) how power plant outages were modeled under extreme cold. Mr. Wilson also argues that the loads in the Winter Peak Study provided by the Companies do not align with the Companies' Resource Adequacy Study.²²

Q. DID WITNESS WILSON PROVIDE A RECOMMENDED RESERVE MARGIN?

A. It is unclear from Witness Wilson's testimony whether he has included a recommended reserve margin. In Witness Wilson's report attached to his testimony as Exhibit B ("Wilson Report"), Witness Wilson states "[i]f the flaws I have identified were even partially corrected, the 14.5% summer planning reserve margin that was in place until the 2016 IRP, which would provide a 16.5% winter reserve margin, would be more than adequate."²³ This statement is puzzling because a 14.5% summer reserve margin for the Companies does not result in a 16.5% winter reserve margin. In fact, if DEP plans the system to meet a 14.5% summer reserve margin, its winter reserve margin will be less than 5% due to its high solar penetration which has the net effect of

²¹ Environmental Parties Wilson Direct, at 7-8.

²² *Id.*

²³ *Id.* at Exhibit B, at 8.

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1 increasing summer reserve margin significantly more than winter reserve margin. This
2 relationship is shown throughout the Resource Adequacy Study and accompanying
3 reports.²⁴ Mr. Wilson's statement demonstrates he does not understand this
4 fundamental relationship between summer and winter reserve margins for the
5 Companies. Further adding to the confusion is Witness Wilson's response to the
6 Companies' discovery requests on this issue, which states, "Mr. Wilson's testimony
7 did not purport to recommend a specific reserve margin."²⁵ While Mr. Wilson's
8 recommended reserve margin is unclear, his testimony, in totality, advocates for
9 changes to the Resource Adequacy Study that would lower the reserve margin.

10 **Q. WHAT WOULD BE THE PRACTICAL AFFECT OF LOWERING THE**
11 **RECOMMENDED RESERVE MARGIN AS WITNESS WILSON**
12 **RECOMMENDS?**

13 A. Lowering the target planning reserve margin below 17% in the winter would result in
14 less generation available to meet load during extreme weather events. Being that the
15 Companies are already at the low end of the range of winter reserve margins in the
16 region, as discussed earlier in my rebuttal testimony in response to ORS, and in light
17 of recent Texas events, a lower winter reserve margin adds risk to customers during
18 extreme cold events.

²⁴ DEP 2020 Resource Adequacy Study, at 44.

²⁵ See Wintermantel Rebuttal Exhibit 1.

1 **Q. AS TO WITNESS WILSON'S FIRST ISSUE OF MODELING EXTREME**
2 **COLD, WITNESS WILSON DISAGREES WITH THE ASTRAPÉ**
3 **REGRESSION APPROACH TO MODELING LOADS DURING EXTREME**
4 **COLD TEMPERATURES. CAN YOU PLEASE EXPLAIN THE GENERAL**
5 **APPROACH ASTRAPÉ TOOK?**

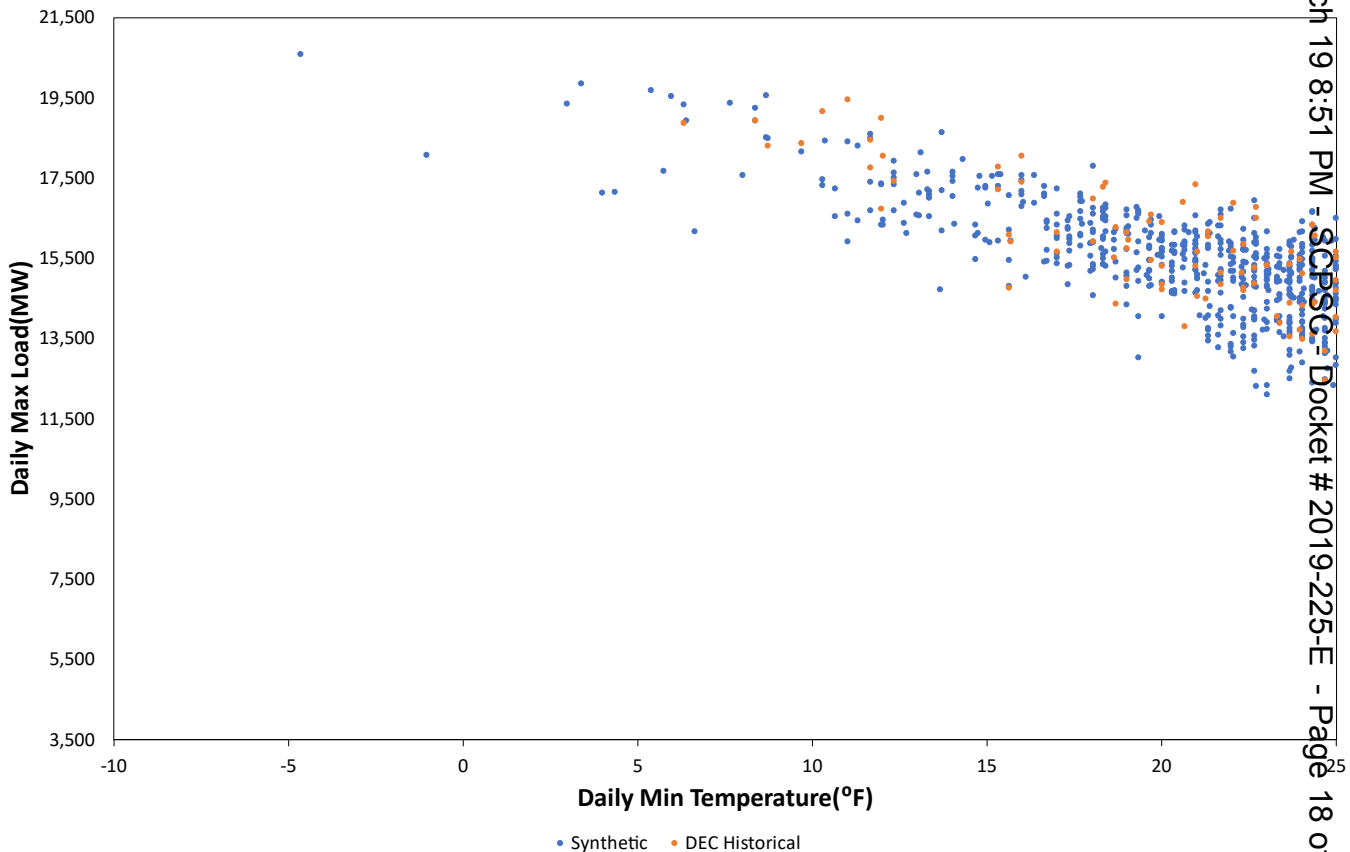
6 A. As I discussed in response to ORS earlier in my rebuttal testimony, the regression
7 equations based on recent historic data are used to extrapolate the loads that would be
8 seen at extreme cold temperatures that were not seen in the five-year historical training
9 data set. These regression equations are created based on the relationship between
10 historical peak daily load and minimum temperature. Astrapé selected a temperature
11 threshold for each of the regression equations for DEC, DEP-E, and DEP-W and then
12 applied the regression analysis for all days that met the temperature threshold.

13 **Q. HOW DID ASTRAPÉ VERIFY ITS REGRESSION EQUATIONS WERE**
14 **REASONABLE?**

15 A. As shown in Figure 2 and Figure 3 below (included as Figure 4 in the Resource
16 Adequacy Study), the historical daily peaks (shown in orange) were plotted against
17 synthetic daily peaks (shown in blue) as a function of temperature. These synthetic
18 daily peaks plotted include the ANN results plus any adjustment made using the
19 regression analysis on extreme cold days. Reviewing the relationship between the
20 historical data and the synthetic data demonstrates the two are extremely correlated and
21 shows how the synthetic loads were extrapolated for the colder temperatures. In
22 looking at the historical data (shown in orange), it does not show a significant decrease

in load response at colder temperatures that Mr. Wilson claims exists.²⁶ Part of the reason for this significant winter load response is the south region of the U.S. has the highest percentage of residential electric heating load compared to other regions in the country.²⁷ Further, DEP has a higher percentage of residential load compared to DEC, causing an even higher load response.

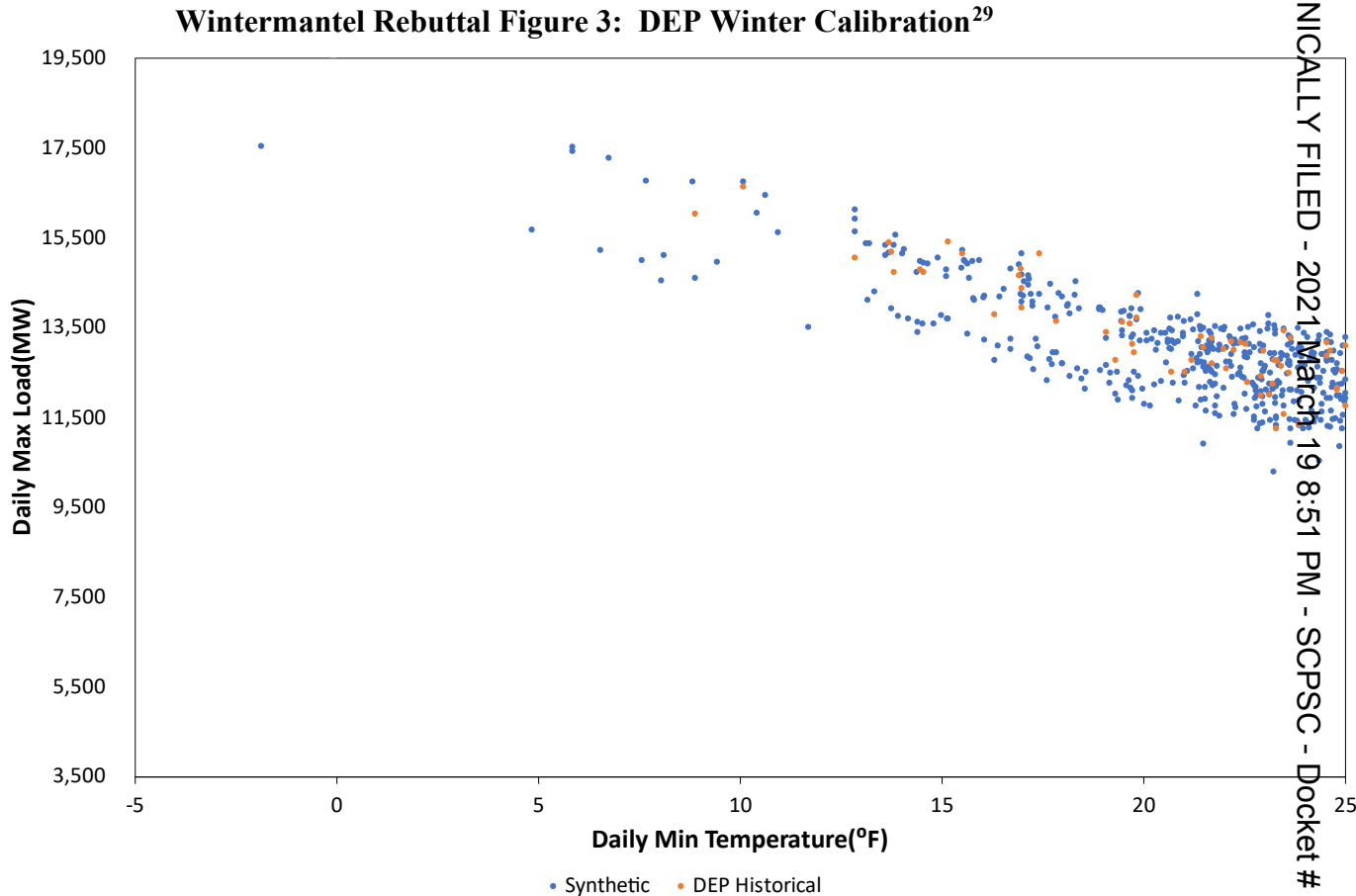
Wintermantel Rebuttal Figure 2: DEC Winter Calibration²⁸



²⁶ Environmental Parties Wilson Direct, Exhibit B, at 9.

²⁷ U.S. Energy Information Administration, *What's New in How We Use Energy at Home: Results from EIA's 2015 Residential Energy Consumption Survey*, at 7 (revised May 2018), available at https://www.eia.gov/consumption/residential/reports/2015/overview/pdf/whatsnew_home_energy_use.pdf.

²⁸ DEC 2020 Resource Adequacy Study, at Figure 4.



Q. DID ASTRAPÉ ANALYZE DIFFERENT COLD TEMPERATURE THRESHOLDS TO SEE HOW IT MAY CHANGE THE REGRESSION EQUATIONS?

A. Yes. Realizing that regression equations are sensitive to the selected data points, Astrapé analyzed the regression equation using a range of historically observed temperatures to ensure the load response in MW per degree was reasonable and not an outlier for a specific subset of data. The load response in MW per degree used in the studies was compared to other permutations utilizing different temperature thresholds and was found to represent a reasonable relationship. As discussed previously in my

²⁹ DEP 2020 Resource Adequacy Study, at Figure 4.

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1 response to ORS, these regression equations were presented to stakeholders prior to
2 performing the simulations and there was no objection from any participant.

3 **Q. CAN YOU PLEASE EXPLAIN THE APPROACH WITNESS WILSON TOOK**
4 **IN RECOMMENDING REGRESSIONS IN FIGURES JFW-1 AND JFW-2?**³⁰

5 A. Witness Wilson used the same data as Astrapé but selected different points to form the
6 regression equations which are then used to correct the peak loads during extreme
7 weather. The data can be seen in Figure 4 and Figure 5 below. Temperature is plotted
8 on the x-axis and load is plotted on the y-axis. As temperature decreases, load increases
9 and the value on each trendline represents the load response in MW per degree for that
10 trendline. For example, the “(10-20 °F)-Astrapé” trendline shows that for every degree
11 below 20 °F, load is expected to increase by 263 MW. Compare the “(10-20 °F)-
12 Astrapé” trendline with Mr. Wilson’s trendline, which is labeled “(12-16°F)-
13 Wilson.” Based on Astrapé’s review, it appears that Witness Wilson selected a set of
14 points that produces the lowest load response possible (99 MW per degree). As shown
15 in Figure 4 below for DEP East, he included only four points in his trendline and also
16 removed the coldest temperature at 10 degrees. Mr. Wilson’s rationale for removing
17 this temperature, as stated in responding to discovery, is that it is an outlier which is
18 “an observation that lies an abnormal distance from the trend reflected in the other
19 members of the population.”³¹ Given that a resource adequacy study examines the
20 system behavior during extreme weather periods, historical data points with extreme
21 weather, while infrequent, are vital for the accuracy of the study because they provide

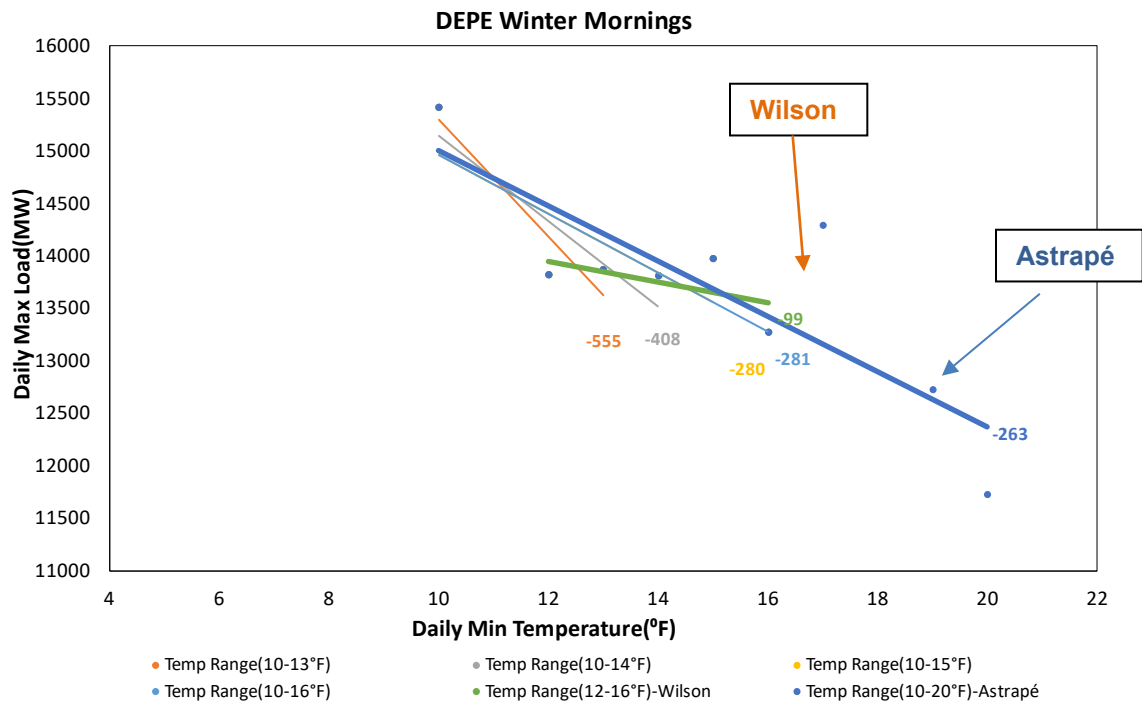
³⁰ Environmental Parties Wilson Direct, Exhibit B, at 15-16.

³¹ See Wintermantel Rebuttal Exhibit 2.

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the most information in relation to load response. By removing this data point, Mr. Wilson is removing one of the more valuable data points the Companies can rely on to estimate cold weather loads. The resulting regression trendlines including different temperature thresholds are much more representative of the 263 MW per degree relationship that Astrapé ultimately used compared to the 99 MW per degree relationship included by Witness Wilson in JFW-2. This analysis shows that even though there are a range of regression trendlines that could have been utilized, the one ultimately chosen does not “overstate the impact of incremental cold on load at the lowest temperatures,”³² as alleged by Witness Wilson.

**Wintermantel Rebuttal Figure 4:
DEP East Load Response to Cold Weather Regression Trendlines**

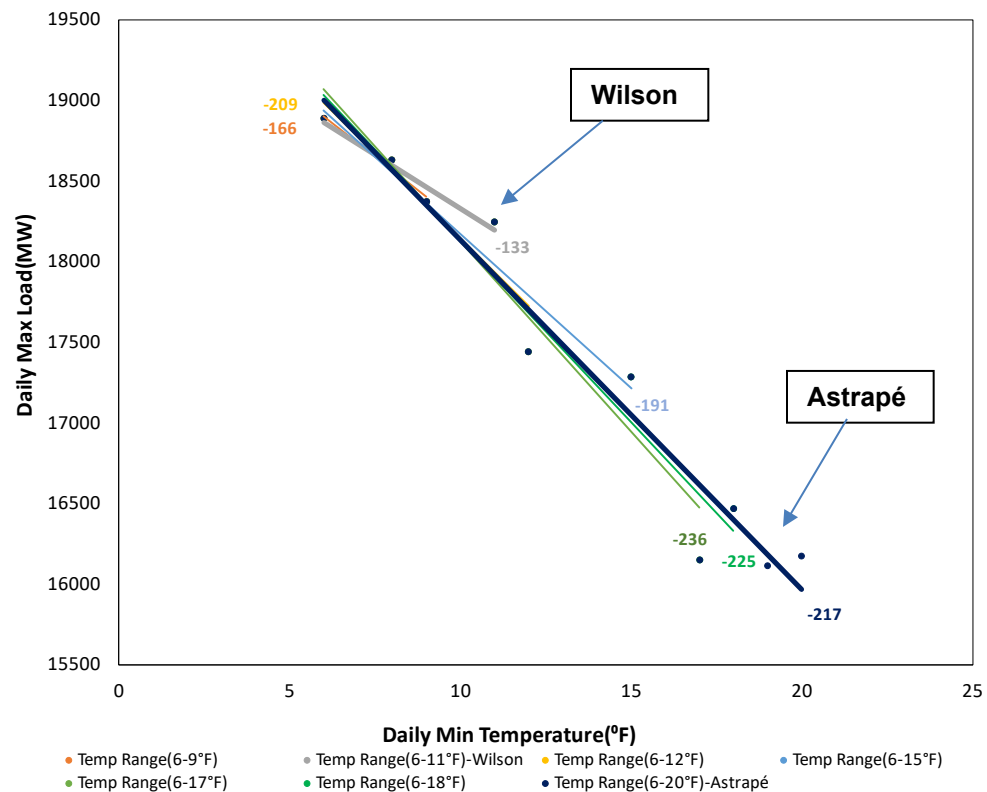


³² Environmental Parties Wilson Direct, Exhibit B at 12.

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Figure 5 below shows the same problem in Witness Wilson's recommended regression equation for DEC. Similar to DEP, he included only four points which resulted in a relatively flat curve. Mr. Wilson's curve is labeled Temp Range (6-11°F)-Wilson and produced a load response of 133 MW per degree compared to Astrapé's that produced a load response of 217 MW per degree. Astrapé analyzed combinations of the data points below 20 degrees including a combination that only included the 3 coldest points, all of which showed a higher load response than Witness Wilson. Witness Wilson's analysis should be rejected as it is not a reasonable representation of the data and significantly underestimates customer risks.

**Wintermantel Rebuttal Figure 5:
DEC Load Response to Cold Weather Regression Trendlines
DEC Winter Mornings**



Q. GIVEN ERCOT'S RECENT FEBRUARY EXTREME EVENT, HOW DOES THE LOAD UNCERTAINTY DUE TO COLD WEATHER MODELED BY ASTRAPÉ IN THE 2020 RESOURCE ADEQUACY STUDY COMPARE TO WHAT ERCOT RECENTLY EXPERIENCED?

A. As shown in Figure 3 of the Resource Adequacy Study, the most extreme cold weather year out of the 39-year history, which is 1985, is modeled as 18%³³ above the winter weather normal forecast for DEC and 21% above the weather normal forecast for DEP. This 18% - 21% variance above the normal weather forecast is much lower than the variance in load seen recently in the ERCOT extreme winter event. Recent data from ERCOT shows that the winter peaks were approximately 29% above the weather normal forecast in the most recent February winter storm. The weather normal forecast going into the winter was 59,567 MW³⁴ and while ERCOT doesn't know precisely the actual load at the coldest temperatures due to load shedding procedures, ERCOT projected a peak load of 76,819 MW.³⁵ This represents an actual load 29% $(76,819 \text{ MW} / 59,567 \text{ MW}) - 1$) above the weather normal forecast developed prior to the winter season. The load did reach 69,692 MW³⁶ on Sunday, February 14, 2021, before the cold temperatures arrived on Monday, February 15, 2021, and Tuesday, February 16,

³³ The 18% and 21% values for DEC and DEP only include the weather variance on load in the modeling. The asymmetric economic load forecast error which actually reduced reserve margins would add 3.1% to these values under the worst scenario modeled.

³⁴ See ERCOT, *Report on the Capacity, Demand and Reserves (CDR) in the ERCOT Region, 2020-2029*, at 22, (Dec. 5, 2019) available at <http://www.ercot.com/content/wcm/lists/167023/CapacityDemandandReserveReport-Dec2019.pdf>.

³⁵ Bill Magness—President & Chief Executive Officer ERCOT, *Review of February 2021 Extreme Cold Weather Event-ERCOT Presentation*, at 19 (Feb. 24, 2021), available at http://www.ercot.com/content/wcm/key_documents_lists/225373/2.2_ERCOT_Presentation.pdf.

³⁶ ERCOT, *Hourly Load Data Archives*, 2021 ERCOT Hourly Load Data (2021), available for download at http://www.ercot.com/gridinfo/load/load_hist.

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1 2021, reflecting a 17% variance from the forecast on a weekend. I also note that the
2 latest ERCOT Winter Assessment assumed an extreme scenario would produce loads
3 only 16% above the expected weather normal forecast.³⁷ Obviously, ERCOT which
4 had not seen temperatures this extreme since 1989, under forecasted load for these
5 extreme cold events. This load variance of 29% above the weather normal load forecast
6 realized in ERCOT is much higher than the 18%-21% maximum load variance included
7 in the DEC and DEP studies.

8 **Q. WITNESS WILSON ASSERTS THAT THE RESOURCE ADEQUACY STUDY**
9 **OVERSTATES THE LIKELY FREQUENCY OF EXTREME COLD**
10 **WEATHER. DO YOU AGREE WITH THIS ASSESSMENT?**³⁸

11 A. No. I do not. A resource adequacy study similar to the one Astrapé performed for the
12 Companies is a probabilistic study that analyzes possible outcomes to determine the
13 reserve margin that meets the one day in 10-year (0.1 LOLE) standard. The most
14 accurate way to capture this is by representing the frequency of cold weather events
15 based on historical data. Each of the 39 weather years has an equal probability of being
16 selected so the years with extreme cold weather were not given any more weight than
17 less extreme cold weather years. As explained earlier in my rebuttal testimony,
18 removing the most extreme weather years artificially deflates the reserve margin and
19 increases the reliability risk during less extreme years resulting in increased risk to
20 customers. By using weather data from 1980-2018, Astrapé is providing a diverse set
21 of weather conditions that includes years which are cold, hot, and mild.

³⁷News Release: Seasonal Assessments Show Sufficient Generation for Winter and Spring (Nov. 5, 2020),
available at <http://www.ercot.com/news/releases/show/216844>.

³⁸ Environmental Parties Wilson Direct, at 5.

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Also, as I described earlier in my rebuttal testimony, the recent extreme weather seen in ERCOT had not been seen since 1989, showing that extreme weather continues to challenge grid operators, and it would be a severe understatement of risks for these weather years to be excluded from the distribution. In fact, as I mentioned previously in my rebuttal testimony, EPRI has recently released a report that states extreme weather events are becoming more, not less, frequent.³⁹ In the same way that engineers, insurance companies, and farmers have to consider many years of data to understand risks of extreme droughts, floods, hurricanes, and tornadoes, electric system planning requires a large sample size to understand the risk of low probability cold or hot temperature events.

Q. MR. WILSON DISCUSSES A WINTER PEAK STUDY CONDUCTED BY THE COMPANIES AND COMPARES THE PEAK DAY USED IN THAT STUDY TO THE LOADS IN THE 2020 RESOURCE ADEQUACY STUDY. WHAT IS THE RELATIONSHIP BETWEEN THESE LOADS EVALUATED IN THESE TWO STUDIES?

A. The Winter Peak Study and the Resource Adequacy Study are two entirely separate studies conducted for two very different purposes. The Winter Peak Study conducted by the Companies represents an actual 2018 actual peak load event. The highest loads in the Resource Adequacy Study represent the most severe weather that could occur for the 2024 study year. Any conclusion Witness Wilson attempts to draw from this comparison is invalid because he is essentially comparing “apples to oranges” as the Resource Adequacy Study represents loads that could occur in the 2024 study year

³⁹ *Supra* at note 18.

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1 while the Winter Peak Study represents a single load event from 2018. DEC/DEP
2 Witness Snider provides further discussion of the Winter Peak Study.

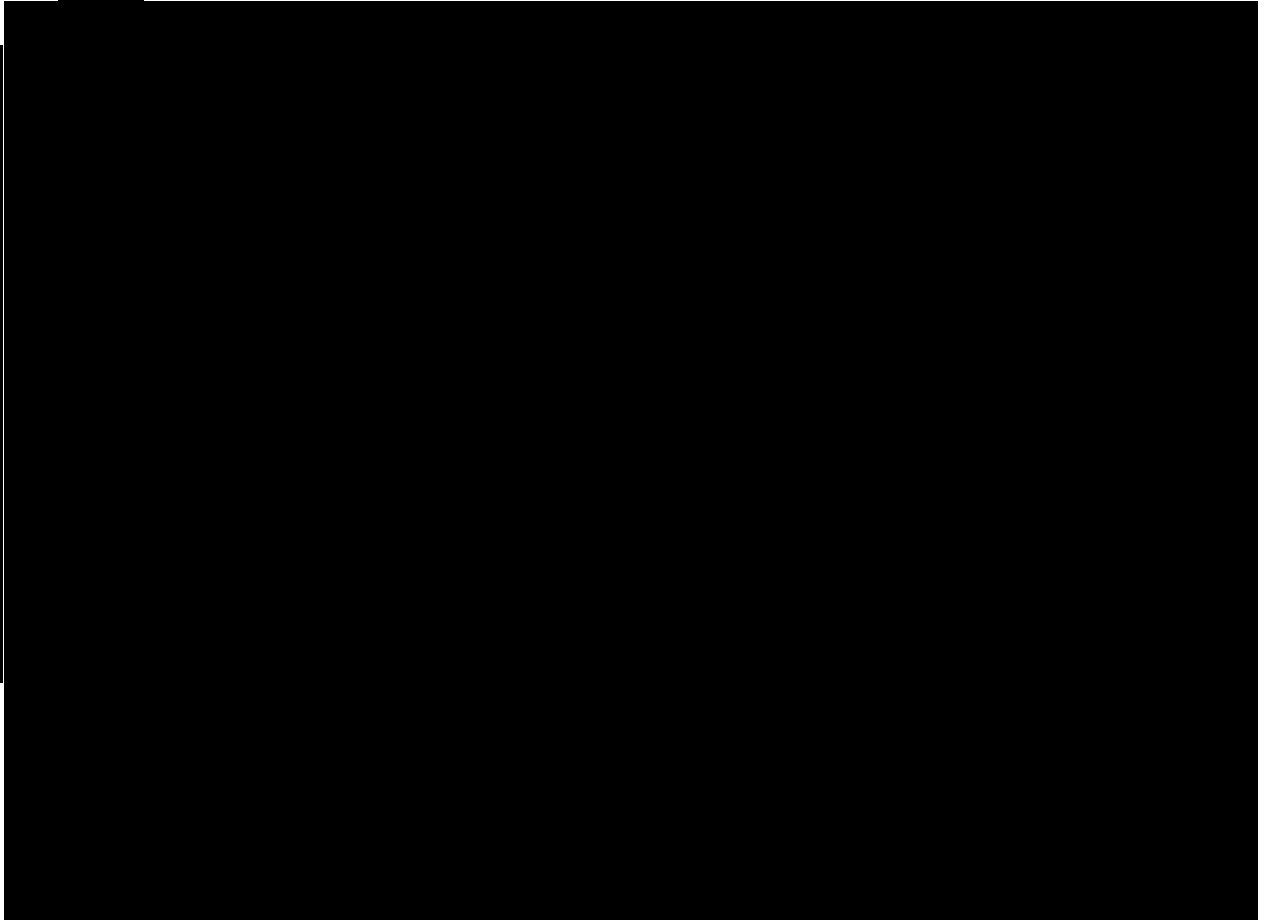
3 **Q. WITNESS WILSON ALSO CLAIMS THAT “THE RESOURCE ADEQUACY**
4 **STUDIES ALSO EXAGGERATED WINTER RESOURCE ADEQUACY RISK**
5 **BY INCLUDING 400 MW OF ADDITIONAL FORCED OUTAGES UNDER**
6 **ALL SCENARIOS UNDER 10 DEGREES.”⁴⁰ HOW DO YOU RESPOND TO**
7 **THIS CLAIM?**

8 A. I disagree with Mr. Wilson’s claims. As explained in Resource Adequacy Study, an
9 extensive calibration process was undertaken to ensure that the amount of incremental
10 outages due to extreme cold weather accurately reflected the outages that were
11 experienced historically by the Companies. This extensive analysis included reviewing
12 cold weather outages during the 2014-2019 period and 2016-2019 period. The 2016-
13 2019 dataset includes post-winter hardening conducted by the Companies’
14 Confidential Figure 6 below demonstrates that it is reasonable to include 400 MW of
15 cold weather outages across DEC and DEP combined and is actually much less than
16 the outages seen below 10 degrees in the 2014 – 2019 dataset in red. The outages from
17 the 2014-2019 dataset would support using an outage amount greater than 400 MW but
18 the Companies and Astrapé opted to base the analysis on the 2016 – 2019 dataset.
19 Furthermore, these outages are only applied in the model when temperatures reach
20 below 10 degrees which represents only the most of extreme cold days.

⁴⁰ Environmental Parties Wilson Direct, Exhibit B at 25.

[BEGIN CONFIDENTIAL]

**Wintermantel Rebuttal CONFIDENTIAL Figure 6.
Average Cold Weather Outages as a Function of Temperature**



[END CONFIDENTIAL]

Q. DO YOU BELIEVE WITNESS WILSON AGREES THAT COLD WEATHER OUTAGES SHOULD BE MODELED?

A. Yes. Witness Wilson estimates that “a value closer to 200 MW would be a better estimate of cold weather outages” based on the slopes of trendlines created from the average MWs of cold weather outages at each temperature.⁴¹ However, Astrapé believes that 400 MW is a more appropriate amount given the information shown in

⁴¹ Environmental Parties Wilson Direct, Exhibit B at 27.

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1 Confidential Figure 6 and that during the January 2018 polar vortex, both DEC and
2 DEP had a combined [BEGIN CONFIDENTIAL] [REDACTED] [END CONFIDENTIAL] MW
3 of cold weather-related outages when temperatures reached 10.28 degrees.

4 Additionally, Witness Wilson attempts to disqualify using the outage data from
5 January 3, 2018 to calibrate the cold weather outages because “this was a quite unusual
6 date – the outage was very early Tuesday morning following a three-day New Year’s
7 weekend.”⁴² When asked through discovery to further explain the relevance of this
8 statement, Witness Wilson responded that “There are many ways the unusual
9 circumstances of this date (the morning following the 3-day New Year’s weekend)
10 could have impacted the plant staff’s ability to address the circumstances that led to the
11 outage. Many people are traveling on the last day of a holiday weekend, and could be
12 delayed and not get their normal sleep.”⁴³ This perplexing and nonsensical justification
13 for disqualifying otherwise proper data is only further evidence of Witness Wilson’s
14 pattern of ignoring data that is not helpful to the outcome he hopes to achieve in this
15 docket.

16 **Q. GIVEN RECENT EVENTS IN TEXAS, HOW DO THE COMPANIES’ COLD**
17 **WEATHER OUTAGES MODELED COMPARE TO THAT EVENT?**

18 A. Recent events in Texas saw more than 52 GW (or, 52,000 MW) of generation offline⁴⁴
19 at a single point in time during the cold weather events. This compares to an
20 incremental 400 MW assumed for the combined DEC and DEP systems during cold
21 weather events. The 400 MW is equivalent to losing a portion of a single combined

⁴² *Id.* at 26.

⁴³ *See* Wintermantel Rebuttal Exhibit 3.

⁴⁴ *Supra* at note 17.

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1 cycle unit in the extreme temperatures below 10 degrees. At extremely cold
2 temperatures system components can fail and while the Companies have invested in
3 winter hardening in their units, it is expected there will continue to be challenges on
4 unit availability during these extremes. The severity of cold weather outages played a
5 major role in the extended blackouts in Texas.

6 **Q. DO YOU BELIEVE WITNESS WILSON'S TESTIMONY AND**
7 **RECOMMENDATIONS IN THIS PROCEEDING ARE REASONABLE AND**
8 **UNBIASED?**

9 A. I do not. From my experience analyzing Witness Wilson's review of both the 2016
10 DEC/DEP Resource Adequacy Study and the 2020 Resource Adequacy Study, Witness
11 Wilson's opinions and recommendations always serve one purpose: to reduce the
12 reserve margin. Based on my experience, Witness Wilson has never provided a critique
13 about an assumption that he believed, if changed, would increase reserve margins.

14 **V. RESPONSE TO WITNESS OLSON**

15 **Q. PLEASE PROVIDE AN OVERVIEW OF WITNESS OLSON'S TESTIMONY.**

16 A. Witness Olson provides several recommendations with regard to how the Companies
17 develop the effective load carrying capability ("ELCC") of solar and energy storage.
18 My testimony addresses the recommendations specific to the 2020 Storage ELCC
19 Study and 2018 Solar Capacity Value Studies that Astrapé conducted for the
20 Companies. Other DEC/DEP witnesses address the remaining recommendations of
21 Witness Olson.

1 **Q. PLEASE DESCRIBE THE COMMENTS AND RECOMMENDATIONS FROM**
2 **WITNESS OLSON THAT YOUR REBUTTAL TESTIMONY ADDRESSES.**

3 A. My rebuttal testimony addresses the following recommendations from Witness Olson
4 regarding the 2020 Storage ELCC Study and 2018 Solar Capacity Value Study:

- 5 1. The need for an ELCC “surface;”
- 6 2. Revisions to the 2018 Solar Capacity Value Study to use a 2040 load profile, to
7 change demand response values, and to change future solar technology
8 assumptions; and
- 9 3. Revisions to the Storage ELCC Study to model storage resources on a “preserve
10 reliability” basis as opposed to an economic arbitrage basis.

11 **Q. REGARDING YOUR REVIEW OF WITNESS OLSON’S TESTIMONY AND**
12 **EXHIBITS, HAS CCEBA PROVIDED SUFFICIENT INFORMATION TO**
13 **ALLOW YOU AND THE COMPANIES TO CONDUCT A THOROUGH**
14 **REVIEW OF THE ANALYSIS PROVIDED BY WITNESS OLSON?**

15 A. No, they have not. While CCEBA provided responses to some of the questions that
16 were requested through the discovery process, CCEBA refused to provide certain
17 information surrounding the use of the RECAP model, so I was not able to review all
18 aspects of the modeling performed by Witness Olson.⁴⁵

19 **Q. PLEASE REINTRODUCE THE 2020 STORAGE ELCC STUDY AND THE**
20 **2018 SOLAR CAPACITY VALUE STUDY.**

21 A. The 2020 Storage ELCC Study was conducted to analyze the capacity value of battery
22 technology within the DEC and DEP systems. The study analyzes the capacity value

⁴⁵ See Wintermantel Rebuttal Exhibit 4.

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1 of different battery penetrations under a range of solar assumptions. The 2018 Solar
2 Capacity Study was conducted in 2018 and analyzed several solar penetrations for both
3 DEC and DEP to determine the capacity value of solar.⁴⁶ The analysis included fixed
4 and tracking solar. Both of these studies were utilized by the Companies to project the
5 capacity value for storage and solar in the 2020 IRPs.

6 **Q. PLEASE SUMMARIZE THE AREAS OF AGREEMENT WITNESS OLSON**
7 **HAS WITH THE ELCC METHOD USED BY ASTRAPÉ IN THE 2020**
8 **STORAGE ELCC STUDY AND THE 2018 SOLAR CAPACITY VALUE**
9 **STUDY.**

10 A. Witness Olson “strongly agrees with the use of the ELCC method, which more
11 accurately reflects the capacity contribution provided by renewables and energy
12 storage.”⁴⁷ Mr. Olson states that “Duke should be commended for its use of ELCC,
13 which has not yet been universally adopted by utilities across the country.”⁴⁸

14 **Q. HOW DOES WITNESS OLSON DESCRIBE THE CONCEPT OF AN ELCC**
15 **“SURFACE?”**

16 A. Witness Olson describes an ELCC surface as a modeling output that characterizes the
17 ELCC of multiple resources on a given system.⁴⁹ He describes this as necessary in
18 order to capture the diversity benefits of combining resources like solar and storage.⁵⁰

⁴⁶ The capacity value of a resource from a terminology standpoint is essentially interchangeable with ELCC.

⁴⁷ CCEBA Olson Direct, at 15.

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ *Id.*

1 **Q. WITNESS OLSON ARGUES THAT THE COMPANIES SHOULD USE AN**
2 **ELCC “SURFACE” IN ORDER TO RECOGNIZE THE DIVERSITY BENEFIT**
3 **OF SOLAR AND STORAGE BEING ADDED TOGETHER.⁵¹ DO YOU**
4 **AGREE?**

5 A. No, I do not believe this is necessary. I disagree that the Storage ELCC Study ignores
6 the diversity benefit of solar and storage being added together. To the contrary, the
7 Storage ELCC Study takes full advantage of the synergies between solar and storage.

8 **Q. PLEASE EXPLAIN HOW THE STORAGE ELCC STUDY TAKES**
9 **ADVANTAGE OF THE SYNERGIES BETWEEN SOLAR AND STORAGE.**

10 A. The Storage ELCC Study analyzed substantial penetrations of storage ranging from
11 400 MW to 1,600 MW for DEC and 800 MW to 3,200 MW for DEP across two
12 different solar tranches each. The solar tranches are not inconsequential: 4,000 MW
13 and 5,500 MW of solar tranches were studied for DEP while 2,700 MW and 4,500 MW
14 were studied for DEC. The synergy is reflected in the storage capacity values. While
15 solar is creating some of the opportunity for storage to supply capacity, the system
16 should only see that credit when storage is selected in the portfolio since the benefit
17 will not materialize until then. The expansion planning performed by the Companies
18 is appropriately allocating the diversity to the contingent resource decision as discussed
19 by DEC/DEP Witness Kalemba. The Storage ELCC Study provides the capacity value
20 of storage with the synergies between storage and solar included, and the Companies
21 use these results to calculate incremental storage ELCC values to be used in the
22 expansion planning process.

⁵¹ CCEBA Olson Direct, at 16-18.

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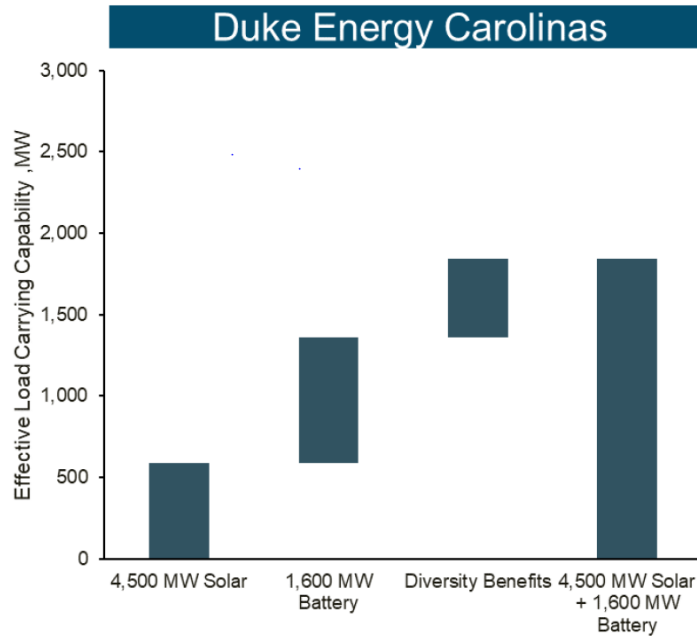
1 Further, because the LOLE is almost all in the winter in DEC and 100% winter
2 in DEP, solar capacity values will remain low (less than 3%) because solar output is
3 low during the morning peak load periods. Because the 2020 Resource Adequacy
4 Study revealed the dominance of winter reliability risk for both Companies, it was not
5 sensible to rerun solar ELCC values.

6 **Q. E3 PERFORMED A STUDY TO EVALUATE THE ELCC OF SOLAR AND**
7 **STORAGE USING ITS RECAP MODEL IN THE DEC SYSTEM. PLEASE**
8 **EXPLAIN THESE RESULTS.**

9 A. Figure 7⁵² below shows the analysis conducted by E3 in its RECAP model for DEC, as
10 presented in Witness Olson's testimony. The major point of his analysis is to show
11 what he believes to be the additional benefit of the combined solar and storage capacity
12 value compared to the individual capacity values.

⁵² Included in CCEBA Witness Olson's Direct Testimony as Figure 2.

Wintermantel Rebuttal Figure 7⁵³: Quantification of ELCC and Diversity Benefits from Solar and a 4-hour Storage Device



Q. IN YOUR REVIEW OF WITNESS OLSON'S STORAGE AND SOLAR ELCC RESULTS PROVIDED IN THE PREVIOUS FIGURE, WHAT DID YOU FIND?

First, I agree with the underlying point that storage and solar have synergistic values. However, as stated previously, the Storage ELCC Study already takes advantage of the solar and storage relationship because significant solar was included in the Storage ELCC Study.

My second observation after reviewing the analysis is that the values shown in Figure 7 are not winter or summer capacity values but annual values, which are not comparable to the capacity values used in the Companies' IRPs. The capacity values used in the IRP require seasonal ELCC values due to the seasonal nature of the LOLE risk. E3 found the average annual ELCC value of solar to be 15% (679 MW/4,500

⁵³ *Id.*

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1 MW = 15%).⁵⁴ This 15% is not useful for expansion planning purposes. The expansion
2 planning analysis conducted by the Companies is driven by incremental winter ELCC
3 values because the winter reserve margin requirement drives future capacity needs. An
4 incremental winter capacity value is the capacity value of the next MW to be added in
5 the winter season. The incremental capacity value is important because as solar and
6 storage penetrations increase, their incremental capacity values decline. If winter
7 ELCC values for solar were provided by E3, I expect they would be in line with
8 Astrapé's analysis. The Companies requested this information through discovery, but
9 CCEBA refused to provide it.

10 Finally, the most problematic portion of the E3 analysis is the calculated value
11 for stand-alone storage. As shown in the previous Figure, E3's assessment quantified
12 the ELCC of 1,600 MW of 4-hour stand-alone storage with 0 MW of solar assumed in
13 DEC to be less than 50%. The standalone storage would result in 721 MW out of 1,600
14 MW in DEC representing a 45% average ELCC. This brings skepticism to the analysis
15 performed by E3 in its RECAP model. Astrapé views the E3 values as exceptionally
16 low for an average ELCC of 4-hour storage even with no solar included which raises
17 questions of the modeling framework. With this analysis in a system with no solar,
18 DEC would only include a 45% capacity credit in its expansion planning models for
19 the first 1,600 MWs of standalone storage which is well below the values used by the
20 Companies. Further, because the capacity value calculated by E3 for standalone 4-hour
21 storage is so low, it is likely the portion allocated as diversity benefit in Witness Olson's
22 analysis is overstated.

⁵⁴ CCEBA Olson Direct, at 17.

1 **Q. WITNESS OLSON RECOMMENDS USING THE PRESERVE RELIABILITY**
2 **APPROACH VERSUS THE ECONOMIC ARBITRAGE MODE IN THE**
3 **STORAGE ELCC STUDY. PLEASE RESPOND TO THIS**
4 **RECOMMENDATION.**

5 A. The Storage ELCC Study conducted by Astrapé produced results for both preserve
6 reliability and economic arbitrage modes to understand the impact of the different
7 operational modes of storage. As discussed within the Storage ELCC Study, the
8 preserve reliability mode assumes the battery will remain fully charged at all times and
9 will only be discharged during reliability events.⁵⁵ In contrast, the economic arbitrage
10 mode assumes the battery will, on a daily basis, operate to maximize economic value
11 and be charged during low-cost hours and discharged when system energy costs are
12 high. In the end, the difference between the preserve reliability mode and economic
13 arbitrage mode capacity values is quite small, an average of 6% capacity value across
14 all the stand-alone storage results. As discussed in the Storage ELCC Study⁵⁶, the
15 difference in capacity value represents the imperfect knowledge that exists in real time
16 commitment and dispatch of batteries. Given these uncertainties and the energy limited
17 nature of these resources, Astrapé recommends the economic arbitrage mode be used
18 for utility owned batteries which resulted in a relatively small discount compared to the
19 preserve reliability storage capacity values. Witness Kalemba discusses why the
20 Companies believe the Economic Arbitrage Method is more reasonable.

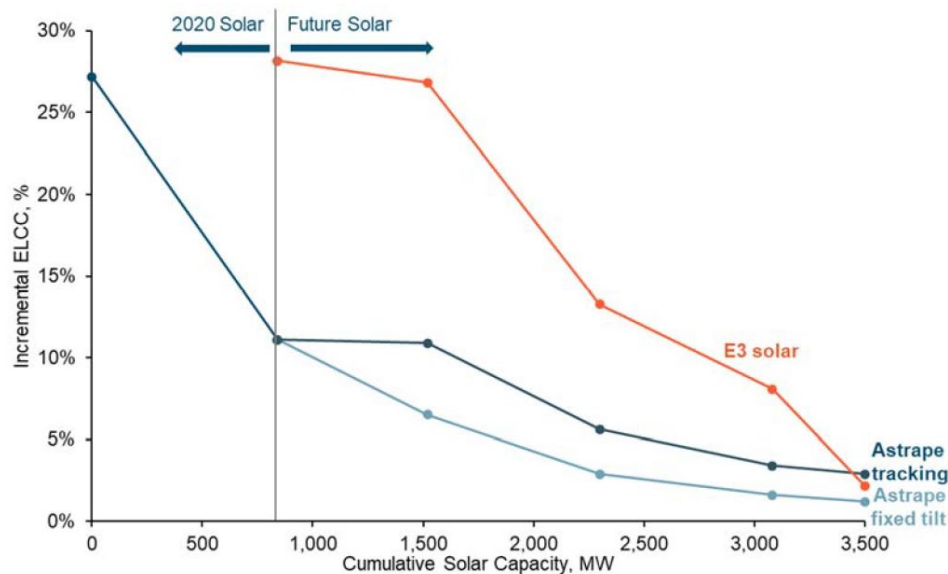
⁵⁵ DEC IRP Attachment IV 2020 Storage ELCC Study, at 8, Docket No. 2019-224-E (filed Sept. 1, 2020) (“DEC Storage ELCC Study”); DEP IRP Attachment IV 2020 Storage ELCC Study, at Docket No. 2019-225-E (filed Sept. 1, 2020) (“DEP Storage ELCC Study”).

⁵⁶ DEC Storage ELCC Study, at 10; DEP Storage ELCC Study, at 10.

Q. MOVING TO THE 2018 SOLAR ELCC STUDY, WHY IS WITNESS OLSON'S ANALYSIS PRODUCING HIGHER SOLAR ELCC VALUES THAN ASTRAPÉ IN THE DEC REGION BUT NOT IN THE DEP REGION.

A. For reference, I have pasted Figure 3 from Witness Olson's testimony⁵⁷ (shown below as Figure 8).

Wintermantel Rebuttal Figure 8: Incremental Solar ELCC Comparisons



Witness Olson states that there were no material differences in the DEP analysis.⁵⁸

After reviewing the results for DEP, as provided in response to discovery, even with higher demand response (E3 assumed 1045.7 MW in the winter), 2040 load, and the removal of cold weather outages, E3 calculates 5 MW of capacity contribution⁵⁹ for all the solar tranches evaluated or essentially 0% capacity value. This is consistent with Astrapé's finding that 100% of the LOLE is in the winter and the capacity value of

⁵⁷ CCEBA Olson Direct, at 25, Figure 3.

⁵⁸ *Id.* at 25.

⁵⁹ This information is based upon data obtained from CCEBA'S response to DEC and DEP's Request for Production No. 1-24(b).

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solar is very small.

For DEC, the most likely reason the results are higher in E3's analysis is because E3 changed certain assumptions that shifted LOLE from the winter to the summer. E3 increased winter demand response from 442 MW to 1,212 MW, utilized 2040 load rather than 2024 load used by Astrapé, and excluded cold weather outages on the generation fleet. I also note that it appears E3 did not model surrounding neighbor load and resources, without which, the loss of load hours can be broader which can in turn artificially increase solar ELCC values. With all of these changes, a portion of the overall LOLE is shifted to the summer in the E3 analysis. The seasonal LOLE differences between the Astrapé analysis and the E3 analysis can be seen in Figure 9 below. Figure 9 shows that the shift to winter LOLE when solar is added is at a slower rate in the E3 analysis. These alternate assumptions increase the annual average ELCC as shown in Witness Olson's analysis but have no bearing on the incremental winter solar ELCC which drives the capacity need. The incremental winter solar ELCC is still very low as demonstrated in the DEP analysis conducted by E3 and Astrapé.

Wintermantel Rebuttal Figure 9: Astrapé vs. E3 DEC Seasonal LOLE at Different Solar Penetrations

Solar Penetration	Astrapé 2018 Solar ELCC		E3 ⁶⁰	
	Winter LOLE	Summer LOLE	Winter LOLE	Summer LOLE
840	69%	31%	46%	54%
1,520	79%	21%	62%	38%
2,300	89%	11%	66%	34%
3,080	93%	7%	74%	26%
3,500	93%	7%	76%	24%

⁶⁰ Calculated based upon data obtained from CCEBA'S response to DEC and DEP's Request for Production No. 1-24a.

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1 **Q. IN YOUR REVIEW WERE THERE ANY OTHER FINDINGS IN THE SOLAR**
2 **ELCC STUDY CONDUCTED BY E3?**

3 A. Yes. In inspecting the results, the E3 RECAP model seemed to produce substantially
4 more reliability problems in February compared to January. This is a non-intuitive
5 result and does not align with Astrapé's own analysis that there is significantly more
6 risk in January than in February. For the highest solar penetration analyzed for DEC,
7 E3's RECAP model determined 44% of the loss of load occurred in February while
8 only 22% occurred in January.⁶¹ This is concerning given temperatures and loads are
9 more extreme in January than February.

10 **Q. IS THERE ADDITIONAL INFORMATION THAT YOU HAVE REQUESTED**
11 **FROM CCEBA AND WITNESS OLSON THAT WILL AID IN YOUR**
12 **EVALUATION OF THE RECAP MODEL IF IT IS RECEIVED?**

13 A. Yes. As I described earlier in my rebuttal testimony, CCEBA has refused to provide
14 responses to certain discovery requests related to the RECAP modeling.⁶² Other
15 discovery requests are still outstanding and have not yet been responded to. Of most
16 concern to me is how the RECAP model may be randomly selecting load and solar
17 profiles and how often the extreme cold loads are being included in the modeling. I
18 am under the impression that the RECAP model doesn't simulate every hour in the 39-
19 weather year history to ensure each weather year is given equal probability but due to
20 lack of discovery responses I was unable to verify. The SERVVM framework utilized
21 by Astrapé simulates every hour of all 39 weather years to ensure each year is given

⁶¹ This information is based upon data obtained from CCEBA'S response to DEC and DEP's Request for Production No. 1-24(a).

⁶² See Wintermantel Rebuttal Exhibit 4.

1 equal probability.

2 **Q. REGARDING THE ASSUMPTION CHANGES MADE BY E3 IN ITS SOLAR**
3 **ELCC ANALYSIS, DID E3 BREAK OUT THE IMPACT OF EACH**
4 **ASSUMPTION CHANGE?**

5 A. No, the assumptions were all rolled into one analysis, so the impact of each assumption
6 is not known.

7 **Q. REGARDING THE CHANGES MADE TO WINTER DEMAND RESPONSE**
8 **CAPACITY, DID ASTRAPÉ PERFORM A SENSITIVITY AROUND WINTER**
9 **DEMAND RESPONSE IN THE 2020 RESOURCE ADEQUACY STUDY?**

10 A. While DEC/DEP Witness Snider refutes the demand response assumptions that E3
11 used in its analysis, a sensitivity within the 2020 Resource Adequacy Study was
12 performed which forced winter and summer DSM to be equivalent.⁶³ In this sensitivity,
13 the reliability risk was still almost all in the winter. For example, at a 17% winter
14 reserve margin, 100% of the LOLE in DEP was in the winter and 90% of the LOLE in
15 DEC was in the winter with this increase in winter demand response. Even with this
16 increase in winter demand response, the seasonal reliability risk is very concentrated in
17 the winter given the existing and planned portfolios. While E3 makes the case that
18 there should be resource adequacy risk in the summer, the analysis does not support
19 this conclusion, even when summer and winter DSM are put on an equivalent basis.

⁶³ DEC winter demand responses was assumed to be 1,122 MW and DEP winter demand responses was assumed to be 1,001 MW.

1 **Q. DO YOU AGREE WITH E3'S APPROACH TO MODEL 2040 LOAD IN ITS**
2 **ELCC ANALYSIS?**

3 A. I do not agree with this approach. It is not logical for the Companies to base their
4 reliability for the 2021-2035 planning period on a 2040 load forecast. While system
5 size likely has a very small impact on solar ELCCs in a system as large as DEC and
6 DEP, the more impactful part of using the 2040 loads is that E3 uses summer forecasted
7 loads that are 945 MW higher than the winter forecast, which improperly shifts some
8 of the LOLE to the summer during the 2021-2035 planning period. For example, the
9 2024 average DEC load in the Resource Adequacy Study across all weather years was
10 17,976 MW in the winter and 18,456 MW in the summer. For 2040, E3 used an average
11 winter load across all weather years of 20,606 MW and 21,552 MW in the summer.
12 The larger difference between summer and winter load in the E3 analysis increases
13 winter reserves by approximately 5% compared to summer reserves. Further, the
14 uncertainty around load and the seasonal reliability risk is much more uncertain in the
15 2040 timeframe so I find it inaccurate to base decisions made from 2021-2035 on a
16 2040 load forecast. Considering all of this, E3's recommendation of using 2040 load
17 should be rejected.

18 **Q. YOU MENTIONED THAT E3 DID NOT UTILIZE COLD WEATHER**
19 **OUTAGES IN ITS SOLAR ELCC MODELING. HOW DOES THIS IMPACT**
20 **THE RESULTS?**

21 A. As seen in Texas recently, outages during cold weather events can be significant,
22 making winter a major reliability concern. Because Astrapé models seasonal outage
23 rates as it has occurred in history and also captures additional cold weather outages

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1 below 10 degrees, LOLE in the winter increases compared to the summer. Excluding
2 cold weather outages is one of the input changes made by E3 that would have caused
3 its analysis to show more summer LOLE for DEC. E3 should include seasonal and
4 cold weather generator outages in their modeling to achieve an accurate picture of the
5 seasonal LOLE risk.

6 **Q. WITNESS OLSON DESCRIBES CONCERNS REGARDING THE MODELING**
7 **OF FIXED-TILT VERSUS TRACKING SOLAR IN THE 2018 SOLAR**
8 **CAPACITY VALUE STUDY.⁶⁴ HOW MUCH DIFFERENCE IN WINTER**
9 **CAPACITY VALUE DID THE 2018 SOLAR CAPACITY VALUE STUDY**
10 **SHOW FOR FIXED VERSUS TRACKING?**

11 A. The 2018 Solar Capacity Value Study showed small increases in capacity value in the
12 range of 1-2.5% for incremental tracking versus fixed tilt solar in the winter. In the
13 summer the difference was larger (equating to approximately 10-15%); however,
14 because the Companies are winter planning, the winter capacity values are used in the
15 expansion planning process. While Mr. Olson's critique could be implemented from
16 Figure 10 below by only using the tracking solar for incremental solar, this difference
17 in capacity value would not have any real effect in the expansion planning process.

⁶⁴ CCEBA Olson Direct, at 23-24.

**Wintermantel Rebuttal Figure 10:
2018 Solar Capacity Value Study Results for DEC and DEP**

Solar Capacity at Each Penetration Level (Incremental MW)	Solar Capacity at Each Penetration Level (Cumulative MW)	Penetration Level	Winter	Summer	Annual
0	0	DEC - 0 Solar	2.5%	44.7%	27.2%
840	840	DEC - 840 Existing + Transition	0.9%	33.6%	11.1%
680	1,520	DEC - Tranche 1 - Fixed	0.5%	29.5%	6.5%
780	2,300	DEC - Tranche 2 - Fixed	0.4%	23.1%	2.9%
780	3,080	DEC - Tranche 3 - Fixed	0.2%	19.4%	1.6%
420	3,500	DEC - Tranche 4 - Fixed	0.2%	14.6%	1.2%
680	1,520	DEC - Tranche 1 - Tracking	2.0%	45.3%	10.9%
780	2,300	DEC - Tranche 2 - Tracking	1.8%	36.6%	5.6%
780	3,080	DEC - Tranche 3 - Tracking	1.3%	31.9%	3.4%
420	3,500	DEC - Tranche 4 - Tracking	1.1%	25.6%	2.9%

Solar Capacity at Each Penetration Level (Incremental MW)	Solar Capacity at Each Penetration Level (Cumulative MW)	Penetration Level	Winter	Summer	Annual
0	0	DEP - 0 Solar	1.2%	35.4%	7.2%
2,950	2,950	DEP - 2950 Existing + Transition	0.6%	12.4%	0.6%
160	3,110	DEP - Tranche 1 - Fixed	0.3%	12.2%	0.3%
180	3,290	DEP - Tranche 2 - Fixed	0.3%	11.6%	0.3%
160	3,450	DEP - Tranche 3 - Fixed	0.2%	8.8%	0.3%
135	3,585	DEP - Tranche 4 - Fixed	0.2%	8.2%	0.3%
160	3,110	DEP - Tranche 1 - Tracking	3.2%	22.3%	3.2%
180	3,290	DEP - Tranche 2 - Tracking	3.1%	20.6%	3.1%

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160	3,450	DEP - Tranche 3 - Tracking	2.8%	16.2%	2.9%
135	3,585	DEP - Tranche 4 - Tracking	2.7%	15.3%	2.8%

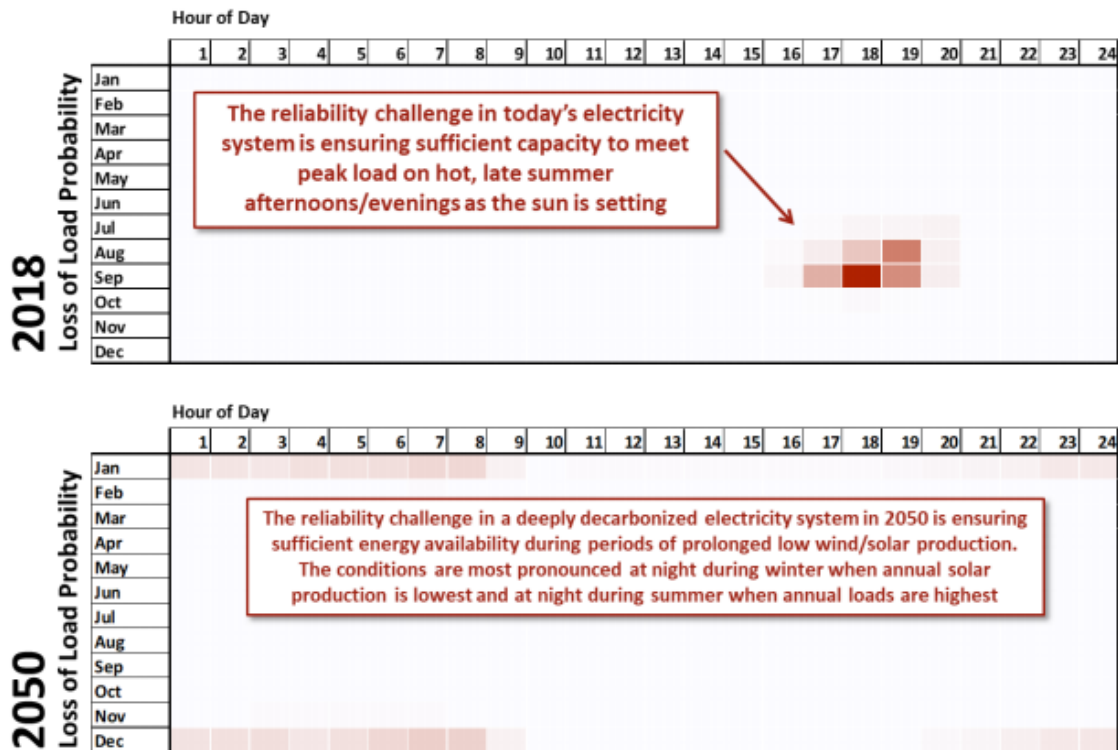
1
2 **Q. PLEASE SUMMARIZE YOUR RESPONSES TO WITNESS OLSON'S**
3 **RECOMMENDATIONS FOR THE STORAGE ELCC STUDY AND 2018**
4 **SOLAR CAPACITY VALUE STUDY.**

5 A. From a storage perspective, contrary to Mr. Olson's claims, the storage ELCCs from
6 the 2020 Storage ELCC Study do take advantage of the synergistic value storage has
7 with solar. The differences between "preserve reliability" and "economic arbitrage"
8 modes are relatively small and given the imperfect knowledge experienced by
9 operators, the economic arbitrage results are reasonable for planning purposes. Lastly,
10 I find some puzzling results in Witness Olson's RECAP model analysis that shows the
11 first 1,600 MW of battery in DEC would have a capacity value of only 45% which is
12 substantially less than any values in the 2020 Storage ELCC Study.

13 All of Witness Olson's arguments to increase the capacity value of solar hinge
14 on artificially creating more LOLE risk in the summer in DEC by improperly
15 modifying several assumptions. Examples of those key assumptions that are
16 improperly modified include increasing demand response to 1,212 MW in the winter,
17 which is refuted by Witness Snider, utilizing 2040 load which is outside of the planning
18 period, and ignoring cold weather outages which increase winter reliability risk.
19 However, even with these assumption changes, winter solar ELCCs will remain low,
20 which drive the capacity requirement in the Companies' expansion planning models.
21 Witness Olson agrees with DEP solar ELCC values because he also forecasts all

reliability risk to be in the winter. In E3's own findings in other jurisdictions and shown in the Figure 11⁶⁵ below, E3 finds that as more solar is added to the system, it is expected that LOLE risk will shift to the winter during periods when the sun is not shining.

Wintermantel Rebuttal Figure 11: Distribution of Loss-of-Load Probability by Month-Hour (High Electrification Scenario)



For the Companies this is especially true because net loads in the studies are most extreme in the winter mornings. The critiques that Mr. Olson provides are inconsequential to the winter solar ELCC values calculated by Astrapé which are used

⁶⁵ Energy and Environmental Economics, Inc., *Long-Run Resource Adequacy under Deep Decarbonization Pathways for California*, at 32 (June 19, 2019), available at [E3_Long_Run_Resource_Adequacy_CA_Deep-Decarbonization_Final.pdf](#) (ethree.com).

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1 within the Companies' IRPs.

2 **Q. WILL YOU UPDATE YOUR REBUTTAL TESTIMONY BASED ON**
3 **INFORMATION THAT BECOMES AVAILABLE AFTER YOUR REBUTTAL**
4 **TESTIMONY IS SUBMITTED?**

5 A. Yes, As I mentioned earlier, to date, CCEBA has refused to provide certain information
6 that would aid in my review of Witness Olson's analysis. Moreover, additional
7 responses from other intervenors to discovery requests are scheduled to be provided
8 within the next week. I fully reserve the right to revise my rebuttal testimony through
9 supplemental testimony should new information not previously provided by
10 intervenors become available.

11 **Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?**

12 A. Yes.